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# PANAVIA TORNADO

## in action


USED IN THE GULF WAR

Aircraft Number 111

squadron/signal publications

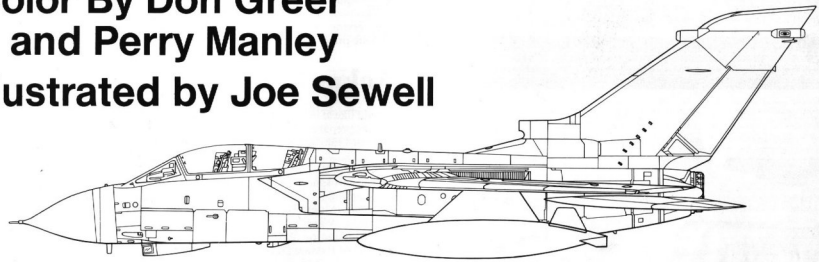
# PANAVIA TORNADO

in action

By Glenn Ashley

Color By Don Greer
and Perry Manley

Illustrated by Joe Sewell



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A pair of Tornado GR.1s of No 31 Squadron climb out in full afterburner. These aircraft were part of the RAF Germany Tornado force until deployed to the Saudi Arabia as part of Operation GRANBY.



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# Dedication:

To Barbara and my parents, Jean and Doug, for their support and all that they had to put up with from this aircraft nut.

This book is also dedicated to the air and ground crews of the Allied Tornado Squadrons serving in Operation DESERT STORM, especially those who have paid the ultimate price.

# Acknowledgments:

I would like to both acknowledge and thank the many people and concerns that helped with the preparation of this book by supplying information and/or photographs. To anyone that I may have overlooked — I apologize.

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No 9 Squadron, RAF
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Mark Gray

**A Tornado GR.1 of No 617 (Dambusters) Squadron taxies out past a Hardened Aircraft Shelter (HAS) towards the active runway. Each HAS can house two Tornados and are spaced apart to avoid blast damage. (MoD)**


53

# INTRODUCTION

The Panavia Tornado had its beginnings on 6 April 1965 (Budget Day in Great Britain) when the Chancellor, James Callaghan, rose in the House of Commons to announce that development costs of English Electric TSR-2 were so high that the project was cancelled. This decision left Britain without a tactical strike and reconnaissance aircraft, and it was stated that the Royal Air Force would purchase a number of General Dynamics F-111s to fill the requirement. This decision was short lived, since the F-111 suffered from a number of technical difficulties as well as rising costs, and the RAF never took delivery of the General Dynamics aircraft.

The TSR-2 had been developed as a replacement for the Canberra bomber and was one of the most advanced strike aircraft under development in the West. In the low-level strike role, the TSR-2 would have been capable of sorties at 200 feet maximum altitude and at speeds in excess of 0.9 Mach while carrying either nuclear or conventional weapons. At higher altitudes the aircraft was expected to cruise at speeds up to Mach 2.05 while combat radius was estimated to be 1,000 nautical miles with a 2,000 pound weapons load. With external fuel tanks this range could be extended to nearly 1,500 nautical miles. The aircraft also incorporated a high, long stroke undercarriage with large, low pressure tires for operations from undeveloped runways or forward operating grass strips just behind the front lines.

As a reconnaissance aircraft the TSR-2 would carry Side-Looking Airborne Radar (SLAR), a moving target indicator on the radar and an infrared linescan system which was capable of providing a TV type image both day and night. Despite its advanced technology, technical problems and rising costs doomed the aircraft.

The next project to interest the British Government was the proposed Anglo-French Variable Geometry aircraft (AFVG) which was intended to be the mainstay of the RAF. Just two years after the TSR-2 was terminated, however, the Minister of Defense, Denis Healey, announced that the French Government had lost interest in the AFVG and had withdrawn from the project. At the same time, he stated that British Aircraft Corporation (BAC) was to continue development of a variable geometry wing aircraft.

BAC, at their plant at Warton near Preston, Lancashire, began building a number of test-rigs needed to develop a successful swing-wing aircraft. General Dynamics had experienced trouble with the stress encountered at the wing roots, as well as difficulty in perfecting the wing pivoting on the F-111. As a result, BAC spent much of their effort on these areas. By the middle of 1968, BAC had produced a successful pivot bearing made of Teflon, giving a better combination of strength and safety, since the fatigue limits on this material were greater than a comparable metal part. BAC also built a complete center wing box that greatly improved the performance of the variable geometry wing.

During this period, the British began negotiations with a number of European countries concerning the possibility of producing a joint, multi-role aircraft to enter service during 1975 (provisionally known as the MRA-75, Multi-Role Aircraft - 1975). The first three countries to join the program were Great Britain, Italy and West Germany. Others joined for a short period, including Belgium, Canada and The Netherlands. Later the title of the project was changed to the Multi-Role Combat Aircraft (MRCA).

To design and build the new aircraft a new company was formed, made up of personnel from all the participating nations; this company was called Panavia and was registered in Germany. Panavia would oversee the contracts and coordinate the work of the prime airframe contractors: BAC in England, Messerschmitt-Bolkow-Blohm (MBB) in Germany, Aeritalia in Italy and the engine contractor, Turbo Union in England.

The prototype MRCA emerged as a twin engined, two seat aircraft with a shoulder mounted variable geometry (swing) wing that was capable of being moved from a full forward position of 25 degrees to a full swept position of 67 degrees. The wing had a provision for two pivoting underwing pylons, with the inboard pylon being configured to accept fuel tanks. The wing had no ailerons, using spoilers to augment the tailerons for roll control. The wing also had full length flaps on the movable portion. The fully movable horizontal tail surfaces, known as tailerons, acted collectively to serve as conventional elevators for pitch control and, when acting independently they served as ailerons for roll control.

The fuselage housed the terrain following radar behind a large pointed radome, the two place cockpit with its single piece cockpit canopy and separate windscreen and both nose and main landing gear wells. Provision was made for two weapons pylons under the fuselage, each capable of carrying a variety of ordnance. It was planned that all offensive ordnance would be carried on these pylons while the wing pylons carried fuel tanks, defensive air-to-air missiles and defensive ECM equipment.

The aircraft was powered by two 16,000 lbst Turbo-Union RB199-34R Mk 101 afterburning turbofan engines, which were expected to give the MRCA a top speed of Mach 2.2 at altitude and Mach 1.2 at sea level.

The first MRCA prototype (prototype 01, serial D-9591) made its first flight on 14 August 1974, at Manching, West Germany. The aircraft was flown by BAC Chief Test Pilot Paul Millett, with MBB Chief Test Pilot Nils Meister as his back seater. The thirty minute test flight was monitored by two *Luftwaffe* chase aircraft, a TF-104 and a G-91T. The flight was conducted at 10,000 feet, and for the first portion of the flight the landing gear was left down. After Millett became accustomed to the aircraft's flight characteristics, he raised the gear and began a series of standard functional trials to test the aircraft's basic aerodynamics.

After completing the flight, Millett made an intentional missed approach and wave-off, followed by a full stop landing. On landing he reported that the aircraft handled very well and no problems were encountered with the aircraft or systems. On 21 September, government and armed forces dignitaries from Great Britain, West Germany and Italy assembled at Manching to witness the "official" first flight of the MRCA.

**On 14 August 1974, the combined efforts of the three nations in the Panavia organization took to the air as the first prototype MRCA P-01 (D-9591) lifted off the runway of the MBB Flight Test Center at Manching, West Germany, in full afterburner. (via R.L.Ward)**

A total of nine prototypes were built (four British, three German and two Italian) each having a designation beginning with the letter P (P-01 through P-09). A tenth airframe (P-10) was constructed; however, this was a non-flying structural test bed used by BAe at Warton. P-02 was the first British built MRCA (serial XX946) and this aircraft along with P-01 were the two workhorses of the early test program. The aircraft were distinguishable from the other prototypes by their unique Red and White color schemes.

P-03 was also a British-built aircraft (serial XX947) which made its first flight on 5 August 1975. This aircraft was different from the others in that it was a dual control aircraft, while all the other prototypes were configured for a pilot and navigator. This aircraft was finished in standard RAF camouflage of Dark Green and Dark Gray uppersurfaces over Light Aircraft Gray undersurfaces.

On 4 October 1976, P-03 suffered an accident when landing in heavy rain at Warton. The aircraft skidded diagonally across the runway and came to a halt in the grass, resting on its nosewheel, wingtip and rear fuselage. As a result of this accident, BAC modified the aircraft, incorporating an augmented, steerable nosewheel, a strengthened undercarriage and some minor alterations to the engine thrust reversers.

Prototype P-04 (serial D-9592) was used in the development of the avionics, while the first of the Italian prototypes, P-05 (serial MM586), seemed to be plagued by problems from the start of its career. After months of delays caused by the lack of a proper engine, the aircraft flew for a little over a month before crash landing at Caselle during January of 1976. It would be another two years before prototype P-05 would take to the air again.

P-06 was another British built prototype which featured a slightly slimmer rear fuselage. During tests it was found that this resulted in slight snaking at speeds just below the speed of sound. Various attempts were made to cure this problem, which was finally solved by modifying the fairing at the base of the fin. P-06 was later tasked with armament testing. These tests included dropping dummy 1,000 pound bombs, flight trials with 1,500 liter (395 gallon) underwing fuel tanks and firing trials with the IWKA-Mauser 27MM internal cannon.

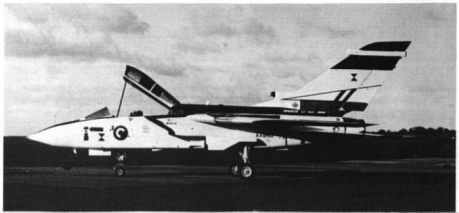
Prototype P-07 was a German-built aircraft used for further avionics development tests while P-08, which was a British built aircraft, was used mainly for developing the weapons delivery systems.

P-09 was also used for weapons trials including the first firing of a Kormoran air-to-surface missile which was being developed for the German *Marineflieger*.

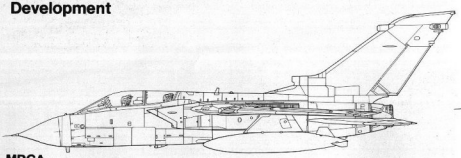
**Three of the prototype Tornados fly formation over Germany. The trailing German aircraft are in the Red and White test scheme while the lead aircraft is in a tactical camouflage. (via R.L.Ward)**

**Prototype P-03 conducts a test flight armed with four German-built Kormoran air-to-surface anti-ship missiles and two Ajax ECM Pods. This aircraft (XX947) was the second British-built prototype. (BAe)**

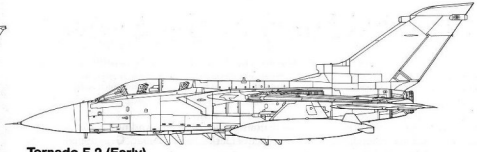
**The second MRCA prototype (XX946) was the first British-built aircraft and was assembled at the BAC plant at Warton. This aircraft flew for the first time on 30 October 1974. The aircraft, like P-01, carried a special Red and White paint scheme. (via R.L.Ward)**



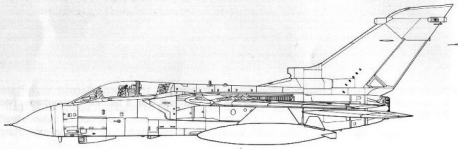
## Development



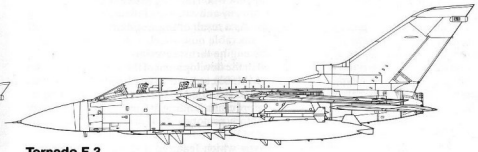
MRCA



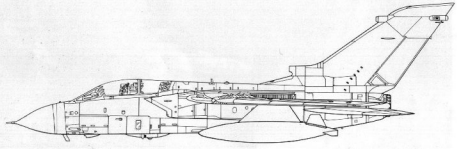
Tornado F.2 (Early)



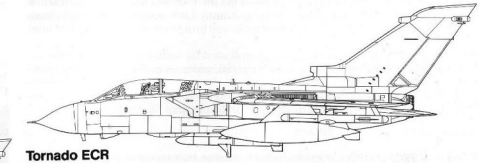
Tornado GR.1/IDS



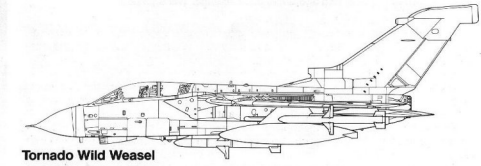
Tornado F.3



Tornado GR.1A



Tornado ECR



Tornado Wild Weasel

# Pre-Production Tornados

As part of the Tornado's continuing development, six pre-production aircraft were authorized under the designations P-11 through P-16. Each would be built a little closer to production standard to test the various components that would go into the final production Tornado.

## P-11

During January of 1976, the first pre-production Tornado (P-11) made its first flight. This aircraft was the first West German built pre-production aircraft and was configured with dual controls.

P-11 was tested by the Federal German Test Center at Manching as part of the final contractual performance trials. P-11 differed from the prototype Tornados in having a fin fillet installed at the base of the rudder. This fillet was standardized and was fitted to all future production aircraft.

During its testing, P-11 was also used as a VIP demonstrator, being flown by a number of service chiefs. On completion of the test cycle, P-11 was retained at Manching by Panavia for measuring total aircraft drag.

## P-12

P-12 (XZ630) was the first aircraft to be officially named Tornado (previously the aircraft was known as the MRCA) and was the first British-built pre-production aircraft. P-12 made its first flight during early 1977, finished in standard RAF camouflage and carrying the unique tri-national roundel markings. During 1978 the aircraft was handed over to the Aeroplane & Armament Experimental Establishment (A&AEE) at Boscombe Down, where a special team assembled to evaluate the aircraft. The evaluation team was made up of members from the four air arms who had ordered the aircraft: the RAF, Italian Air Force, West German Navy and West German *Luftwaffe*.

P-12 differed from the prototypes in that it retained the early engines fitted to the first prototypes but had a production standard airframe. The aircraft was used to finish the development work on the Tornado's avionics and weapon delivery systems. Additionally, the aircraft was used to train future Tornado instructor pilots.

## P-13 through P-16

The last four pre-production aircraft were as close to the final production variant as possible, with only slight internal differences.

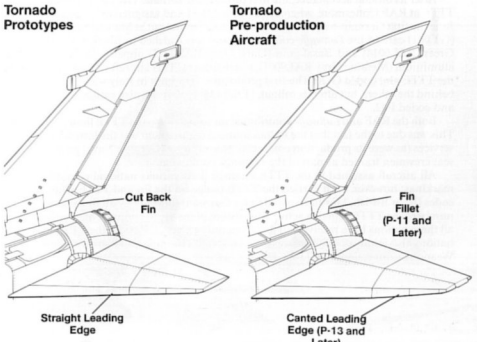
P-13 (D-9802) was another German-built aircraft and was the first to feature a modified leading edge on the taileron. The leading edge was changed from a straight configuration to a kinked leading edge, which bent inward on the outboard panel. The Italians built P-14 (MM588/MM7001) which set the production standards for the wings.

The final British-built pre-production aircraft was P-15 which was basically a a production standard Tornado. The front fuselage was delivered to Manching from Warton and the aircraft was assembled at the MBB plant.

P-16, the last of the pre-production aircraft, was a German built aircraft which was configured to carry Kormoran anti-ship missiles. It made its first flight on 26 March 1979.

**Prototype P-03 refuels one of the pre-production aircraft (P-15) during a demonstration of the buddy pack refueling pod which is carried on the centerline stores pylon. P-03 has the straight leading edge on the tailplane while P-15 has the later canted tailplane. (via R.L.Ward)**

**Tail Development**



# Tri-National Tornado Training Establishment

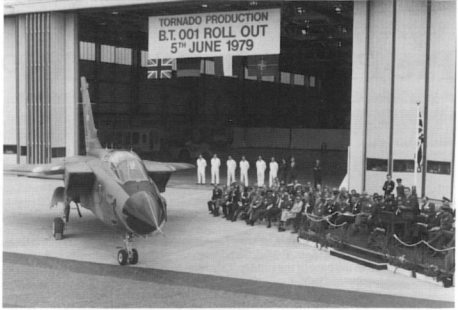
On 5 June 1979, a number of important politicians and high ranking military officers gathered at Warton for the official rollout of the first production Tornado IDS (Interdictor/Strike) aircraft. The aircraft, Tornado BT.001 (ZA319), was rolled out of the hangar beneath the flags of Britain, Germany, Italy and NATO. The aircraft was finished in the standard RAF wraparound camouflage scheme of Dark Green and Dark Sea Grey with toned down Red/Blue national insignia. ZA319 was the first RAF aircraft to be delivered and was designated the Tornado GR.1.

The initial production contracts called for 220 aircraft for the RAF (designated GR.1s) 228 for the *Luftwaffe* (designated the IDS), 96 for the *Marineflieger* (German Navy) and 100 for the *Aeronautica Militare Italina* (Italian Air Force). To ease the transition to the new aircraft, all three countries joined together to form the Tri-national Tornado Training Establishment (TTTE) at RAF Cottesmore, in Leicestershire. Here Tornado crews from all services would be trained using the same basic course. It was important to train crews from all three services together since in time of war they would be flying and fighting as allies, under NATO command.

After its official acceptance, the first production Tornado GR.1 was delivered to the TTTE at RAF Cottesmore, where it was coded B-11 and assigned to C Squadron. On 6 June the first German-built aircraft was officially rolled out at Manching. Tornado IDS (GT.001) carried the *Luftwaffe* code 43+01 and was finished in Black, Gelboliv (Olive Green RAL6014) and Basaltgrau (Dark Gray RAL7012) uppersurfaces over Weissaluminium (Metallic Gray RAL9001) undersurfaces. This aircraft was also assigned to the TTTE and coded G-20. The first production IDS built in Italy was several months behind the others, but after its rollout, IT.001 (MM5500) was also assigned to the TTTE and coded I-42.

Both the RAF and *Luftwaffe* contributed more aircraft to the TTTE than the Italians. This was due to the fact that the Italian training requirement was the lowest of the three services (as were its production contracts). *Marineflieger* (German Navy) pilots and rear seat crewmen trained as part of the *Luftwaffe* contingent.

All aircraft assigned to the TTTE retained their various national camouflage and markings; however, each carried the TTTE badge on the fin and TTTE identification codes (B for British, I for Italian and G for German) followed by an individual aircraft number. The TTTE remains active and current plans are to continue the program until all three nations have received all their remaining aircraft. Besides the TTTE, the three nations also jointly operate the weapons and tactics training unit known as the Tornado Weapons Conversion Unit (TWCU).




**British Minister for Defense, Francis Pym, addressed a gathering of NATO dignitaries during the rollout ceremonies of the first production Tornado. The aircraft was a Tornado GR.1 (ZA319) which was assigned to the TTTE at RAF Cottesmore. (BAe)**

**ZA327 (B-51) of the TTTE during maintenance outside a hangar at RAF Cottesmore. Note the mesh FOD guards on the air intakes and lack of weapons or pylons. (TTTE)**

Three aircraft of the TTTE conduct a training flight over the British countryside. The *Luftwaffe* aircraft (43+20) carries the early camouflage scheme with Metallic Gray undersurfaces. All three aircraft carry the TTTE identification codes in Black with a White outline. (MoD)

Before joining frontline squadrons, Tornado crews undergo weapon training to familiarize them with the Tornado's sophisticated weapon systems. This course is taught using GR.1s and GR.1Ts by the Tornado Weapon Conversion Unit (TWCU) based at RAF Honington. (Tim Laming)

This *Luftwaffe* Tornado IDS aircraft also served with the TTTE. The *Luftwaffe* training contingent at the TTTE trains both Air Force and Navy air crews. (Panavia).

# Tornado GR.1

The Tornado GR.1 entered frontline RAF service on 1 June 1982 with No 9 Squadron at RAF Honington. The unit's aircraft had, in fact, began arriving at the station during early 1982 and were formerly used by the Tornado Weapons Conversion Unit. The Green Bat insignia that adorned the tails of the aircraft had only two months earlier been carried on the Vulcan bomber. As the RAF's first operational Tornado squadron, No 9 Squadron was used for a number of operational trials.

During 1985, No 9 Squadron became the first Tornado unit to participate in a Red Flag Exercise at Nellis AFB in the United States. They were also first to lose an aircraft in an operational accident when ZA586/A crashed near Kings Lynn, Norfolk, on 27 September 1983, killing the pilot.

The next squadron was No 617 (Dambusters) Squadron which is one of the most famous RAF squadrons. The Dambusters were officially reformed at Marham on 16 May 1983, 40 years to the day from the squadron's famous Ruhr dams raid. The squadron was the first Tornado squadron to take part in the USAF bombing competition, Exercise Prairie Vortex, during 1984, finishing as both winner and runner-up. They were backed up during the competition by a number of Victor K.2 tankers of No 55 Squadron. No 617 aircraft carry squadron markings that consist of a Black bar on either side of the roundel with a Red lightning flash on each bar and a Black fin tip with a Red lightning flash.

No 15 Squadron had the dual distinction of being the RAF's third Tornado squadron and the first Tornado unit assigned to RAF Germany. The squadron converted from the Buccaneer S2B. No 15 Squadron was followed by No 16 Squadron who traded their Buccaneers for Tornados reforming on 29 February 1984. Both units were based at RAF Laarbruch.

A month after No 15 Squadron formed, No 27 Squadron was reformed at RAF Marham alongside No 617 Squadron. No 27 was an ex-Vulcan squadron and carries a Green elephant on a Yellow disc on the fin tip. Following the success of No 617 Squadron at Exercise Prairie Vortex 84, No 27 Squadron was scheduled to take part in the next competition at Ellsworth AFB, North Dakota. Again the Tornados stole the show, taking the two first place awards out of some forty-two competitors.

After a long connection of flying from Germany with such types as the Vampire, Sabre and Hunter, No 20 Squadron added the Tornado to the list of aircraft flown from its continental base. On 29 June 1984, the squadron converted from Jaguars and moved to RAF Laarbruch to operate alongside Nos 15 and 16 Squadrons.

Another Jaguar unit that transition to the Tornado was No 17 Squadron, which completed its conversion on 16 August 1984. Unlike No 20 Squadron, No 17 did not move but remained at Bruggen, Germany. During the latter part of 1984, two other RAFG Jaguar squadrons, Nos 31 and 14 Squadrons, traded in their aircraft for Tornados, leaving only one Jaguar squadron, No 2 Squadron, in Germany (which will also convert to the Tornado in the not too distant future).

# Tornado GR.1A

The Tornado's record and performance as a low level strike aircraft is unequaled by any other aircraft in service and the RAF is continuing to upgrade the aircraft. The first system upgrade consisted of the installation of a Laser Ranger and Marked Target Seeker (LRMTS) which is carried in a fairing under the nose. The LRMTS became a

**This Tornado GR.1 (ZA591) of No 9 Squadron carries 1,500 liter (396 gallon) underwing fuel tanks and ECM pods. The "Bats" were the first operational Tornado squadron in the RAF and their unit insignia is Green with a Yellow outline. (Panavia)**

**A Tornado GR.1 (ZA550) of No 617 (Dambusters) Squadron flies formation with a BAe Hawk T.1A of No 1 TWU. No 617 Squadron was the second Tornado squadron to reach operational status. (MoD)**

standard fitting beginning with Production Batch 3 aircraft (ZA365) onwards and is being retrofitted to earlier aircraft.

To meet an RAF requirement for a dedicated reconnaissance variant of the Tornado, a standard Tornado GR.1 was modified with the two internal 27MM Mauser cannons replaced by a horizon-to-horizon Infrared Linescan system, a Side-Looking Airborne Radar (SLAR) system and video recorders. The reconfigured aircraft was designated the Tornado GR.1A and differs externally from the GR.1 in having the gun ports replaced by SLAR windows and in the installation of a small fairing under the forward fuselage for the linescan lens. The Tornado GR.1A is the first reconnaissance aircraft to enter service with no optical cameras, relying totally on video recorders (which can be monitored in flight). One future upgrade project planned for the Tornado GR.1A is the installation of a video data link system that will allow the Tornado GR.1A to transmit video in real-time to a ground station. In addition to its reconnaissance capabilities, the GR.1A retains its full air-to-ground weapons capability.

The first unit to receive the GR.1A was No 13 Squadron, a former Canberra reconnaissance unit. The squadron was officially reformed as a Tornado unit on 10 January 1990, its 75th anniversary as an active RAF unit.

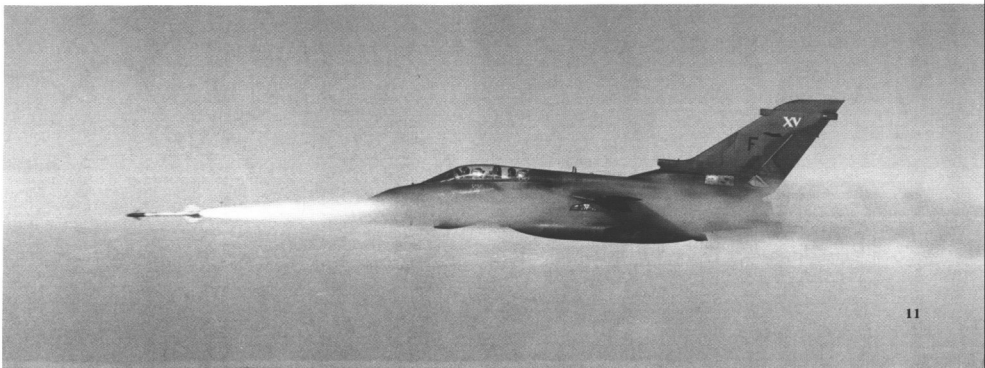
The RAF is engaged in a Tornado mid-life update program which will include the installation of improved sensors and avionics. Included in the program are the installation of a new radar system, a Forward Looking Infrared (FLIR) sensor, Night Vision Goggle capability, a wide angle Head-Up Display (HUD) and an improved ECM suite. Some 165 aircraft are included in the update program and, upon completion, they will be redesignated as Tornado GR.4s.

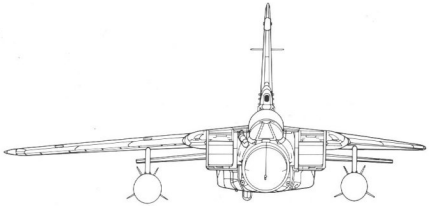
## Tornado GR.1T

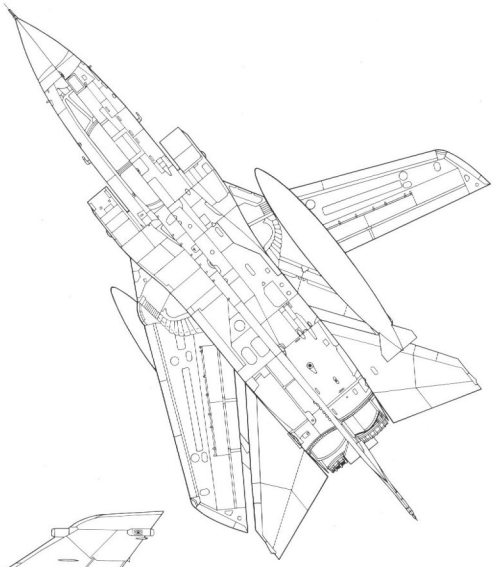
A number of Tornado GR.1/IDS aircraft were built as dual control aircraft for use in pilot transition training. These aircraft are not true two seat trainer variants of the Tornado, but rather fully operational GR.1/IDS strike aircraft with a control stick and basic flight instruments being added to the rear cockpit *in addition to* the normal navigator's equipment. These aircraft are designated as Tornado GR.1Ts in RAF service. In the training role, an instructor pilot occupies the rear cockpit, while the student pilot flies the aircraft from the front cockpit.

In the event of an emergency, the aircraft are fully combat capable with the full range of equipment and weapons as the Tornado GR.1/IDS. To date, the RAF has accepted some forty-nine GR.1Ts, all of which carry a (T) after their serial number to denote trainer.

**The first live firing of an AIM-9 Sidewinder air-to-air missile by a Tornado was carried out by a Tornado GR.1 of No 15 Squadron. The Sidewinder is carried for self-protection with the missile rail being mounted on the inboard side of the inboard underwing pylon. (BAe)**







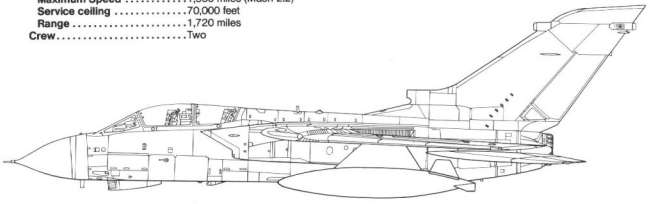
## Specifications

## Panavia Tornado GR.1/IDS

**Wingspan** ..... 45 feet 7.5 inches
**Length** ..... 54 feet 10.25 inches
**Height** ..... 19 feet 6.25 inches
**Empty Weight** ..... 31,065 pounds
**Maximum Weight** ..... 60,000 pounds
**Powerplants** ..... Two 16,000 lbst Turbo-Union RB199-34R Mk 101 turbofan engines.

**Armament** ..... Two 27MM cannons
Two AIM-9L Sidewinder AAMs and up to 19,840 pounds of ordnance.

**Performance**
**Maximum Speed** ..... 1,650 miles (Mach 2.2)
**Service ceiling** ..... 70,000 feet
**Range** ..... 1,720 miles
**Crew** ..... Two



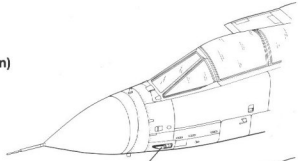
A No 31 Squadron Tornado GR.1 parked outside a Hardened Aircraft Shelter (HAS) on a NATO air base in Europe. The aircraft is carrying a Sky Shadow Electronic Counter-Measures (ECM) pod on the port outboard wing pylon. (Gerrard Beerens)

This Tornado GR.1 (ZD715) is serving with its third squadron. After seeing service with both Nos 20 and 15 Squadrons, it now carries the unit markings of No 31 Squadron at Bruggen, Germany. The star is Yellow and the dart on the nose is Yellow and Green. (Panavia)

Four Tornado Gr.1s of No 31 Squadron conduct a weapons training sortie armed with 1,000 pound bombs on the fuselage stations. They also carry 1,500 liter fuel tanks, a BOZ-107 chaff and flare dispenser on the starboard outboard pylon and a Sky Shadow ECM pod on the port wing outboard pylon. (Panavia)

## Laser Ranger & Marked Target Seeker (LRMTS)

Tornado GR.1
(Early Production)




Tornado GR.1
(Late Production)

LRMTS Pod (Offset To Port)

This Tornado GR.1 (ZQ560) of No 27 Squadron is parked and chocked in front of a Hardened Aircraft Shelter (HAS). In time of war the aircraft would be kept inside the hangar until it was ready to depart on its next sortie. (MoD)

This Tornado GR.1A reconnaissance aircraft was assigned to No. 13 Squadron. A number of these aircraft were later deployed to Saudi Arabia to assist with the search for Iraqi SCUD missile launchers. (Author)

A GR.1T (ZA544) of No 45 Squadron/TWCU makes a low pass revealing the uppersurface camouflage pattern and low visibility national markings. The aircraft has the wings swept forward indicating that this was a slow-low pass. (TWCU/45 Squadron)

A Tornado GR.1 (ZD743) of No 17 Squadron conducts a low level training sortie over the German country side. No 17 has a long tradition of operating in Germany, having flown Phantoms and Jaguars as part of RAF Germany. (Panavia)

A Tornado GR.1T of No 45 Squadron on a low level navigational training flight. The Tornado's swing wing gives the aircraft outstanding performance at low levels. Most Tornado missions are flown at or below 1,000 feet. (MoD)

A pair of Tornado GR.1s of the Tornado Operational Evaluation Unit (TOEU) fly an attack formation over either Scotland or Wales. Tornados conduct low level training in these areas due to their low population levels. (MoD)

This Tornado is assigned to the Royal Aircraft Establishment (RAE) at Bedford. It carries a Red, White and Blue color scheme with high visibility markings. The aircraft is used for a variety of research projects. (RAE Bedford)

# Tornado IDS
## *Luftwaffe* Service

The *Luftwaffe* (West German Air Force) is the second largest operator of the Tornado IDS, after the RAF. The *Luftwaffe's* original requirement was for 212 IDS variants, which was later increased to 228 aircraft. The Tornado was intended to replace the 430 F-104 Starfighters in *Luftwaffe* service, although it is unlikely that the Germans will replace the F-104s on a one for one basis.

Of the 228 aircraft currently on order, 175 are conventional pilot/navigator strike aircraft while fifty-three are dual control trainers (although in time of war these would also be used for strike missions).

The *Luftwaffe* has five home based squadrons as well as a twenty-seven aircraft detachment (A squadron) assigned to the TTTE at RAF Cottesmore in the United Kingdom. The German aircraft assigned to the TTTE carry full *Luftwaffe* camouflage and markings as well as the letter G on the fin along with the aircraft's identification number.

Four of the five home based Tornado squadrons are in the central and southern part of the country, with one *Luftwaffe* unit, RAF Germany Tornado squadrons and the *Marineflieger* (Navy) covering the northern sectors. The single northern unit is JBG-38 based at Jever near the border with the Netherlands. JBG-38 has a dual role, acting as both a frontline strike squadron and as the *Luftwaffe* Tornado training squadron. The training mission involves advanced training for crews working up on the Tornado and/or converting from other aircraft types, such as the F-104 and Fiat G-91.

The two units based in central Germany are JBG-31, based at Norvenich and JBG-33 at Buchel. Both units are assigned to NATO's 2nd Allied Tactical Air Force (2ATAF). Further south are the last two units of the *Luftwaffe* Tornado fleet, JBG-34 at Memmingen and JBG-32 at Lechfeld.

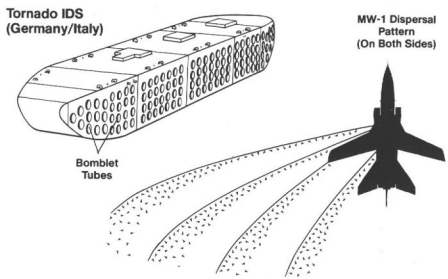
The Tornado entered service with the *Luftwaffe* during 1982 and, as with the RAF, a number of early production aircraft went straight to the TTTE. The early examples were finished in a camouflage scheme of Black, Gelboliv (Olive Green RAL6014) and Basaltgrau (Dark Gray RAL7012) uppersurfaces over Weissaluminium (Metallic Gray RAL9001) undersurfaces. This was later changed to a wraparound camouflage scheme consisting of Dark Green, Medium Green, and Black.

*Luftwaffe* Tornados are capable of carrying the full range of standard NATO weapons in addition to a special anti-armor/anti-personnel weapon developed in Germany, the MW-1 weapons dispenser. The MW-1 is basically a large container carried under the center fuselage station with twenty-eight individual tubes containing anti-armor/anti-personnel sub-munitions (bomblets) on each side. When fired, the munitions are spread in a series of arcs on either side of the line of flight. The bomblets can be set to detonate on contact or with a delayed action. The delayed action feature allows them to act as mines giving he MW-1 an area denial capability.

When carrying the MW-1, the inboard underwing pylons are usually fitted with 1,500 liter (396 gallon) fuel tanks. The two outer wing pylons are usually fitted with ECM and/or Chaff/Flare pods. The common NATO ECM pod is the Westinghouse ALQ-101(V), although some RAF and German aircraft carry the ARI 32346 Ajax ECM pod built by Marconi Space & Defense Systems in the UK. Other defensive pods include the BOZ-100 Chaff/Flare pod and Cerberus ECM Jammer pod.

The Tornado IDS is an extremely versatile aircraft and operates from any reasonable length of straight road that is wide enough to handle the aircraft. The Germans are particularly fortunate in having one of the best autobahn systems in the world, giving them an added advantage in Tornado dispersal in the event of war.

### MBB MW-1 Weapons System




**One of the German prototypes (P-11) carries an MW-1 weapons dispenser on the fuselage centerline station during the weapon's development trials. The MW-1 was developed for the *Luftwaffe* and can be used against both infantry and armored targets. (Panavia)**

# Tornado ECR

During mid-1988, the Germans began work on the Tornado ECR (Electronic Combat and Reconnaissance) version. Two Tornado IDS aircraft were taken from the *Luftwaffe* inventory to serve as project test bed aircraft, with the first of these being completed on 18 August 1988. The aircraft was modified with a new and enhanced computer, wing root antennas for the emitter location system and a forward looking infrared sensor. Additionally, the aircraft had its 27MM cannon replaced by infrared linescan sensors and it is capable of carrying at least two anti-radiation missiles such as the AGM-88A HARM.

The *Luftwaffe* intends to use the Tornado ECR version in a role that is similar to that of the Wild Weasel defense suppression aircraft employed by the USAF. For this mission the aircraft would carry a mixture of intelligence gathering equipment, electronic sensors and anti-radiation missiles. The *Luftwaffe* has identified a requirement for some thirty-five ECR aircraft. The first production Tornado ECR (4623) rolled off the MBB line on 26 October 1989.

# *Marineflieger* (West German Naval Service)

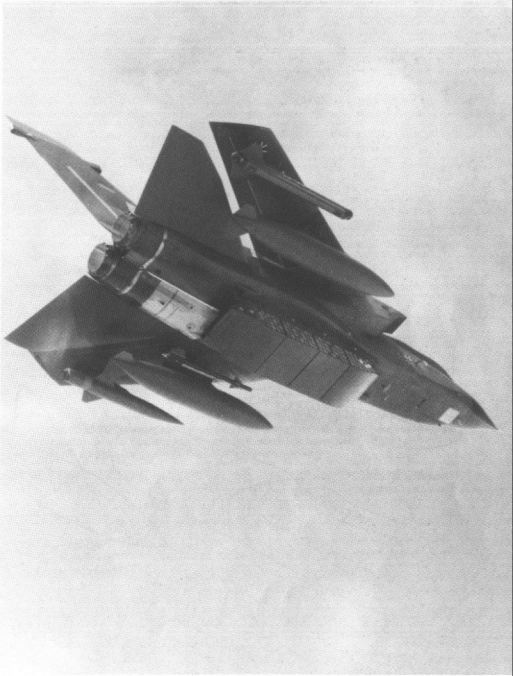
The *Marineflieger* has developed in a similar way to the *Luftwaffe*, operating the same types aircraft although on a much smaller scale. As with the *Luftwaffe*, the *Marineflieger* purchased the Tornado IDS to replace its ageing fleet of F-104 Starfighters. As a result, Tornados for both services are being produced together on the same production line.

The *Marineflieger* has a requirement for ninety-six Tornados to serve in two wings, MFG-1 and MFG-2. The *Marineflieger* has no training detachment at the TTTE, since all Navy crews are included in the *Luftwaffe* training quotas. The first *Marineflieger* aircraft came from the second production run. The aircraft was coded 43+19 and was the 46th Tornado built.

Both *Marineflieger* Tornado Wings are based in the North of Germany and serve in the anti-shipping role. At the present time these are the only anti-shipping Tornados in service, although the RAF will receive a number of GR.1s optimized for this role sometime in the near future. MFG-1 is based at Schleswig-Jagel while MFG-2 is housed at Eggebeck. To meet the anti-shipping requirement, the Germans have developed their own air-to-surface anti-ship missile for the Tornado — the Kormoran.

The Kormoran was developed by Messerscmitt-Bolkow-Blohm and was fired for the first time on 31 July 1978. The test was conducted by the last of the Italian prototypes, P-09 (MM587) on one of the weapons ranges off the island of Sardinia. The missile has been cleared for use on the Tornado IDS/GR.1, but has only been selected for service by the *Marineflieger*. The British have developed their own anti-ship missile (BAe Sea Eagle) which can be carried by Buccaneers and Sea Harriers as well as the maritime strike version of the Tornado.

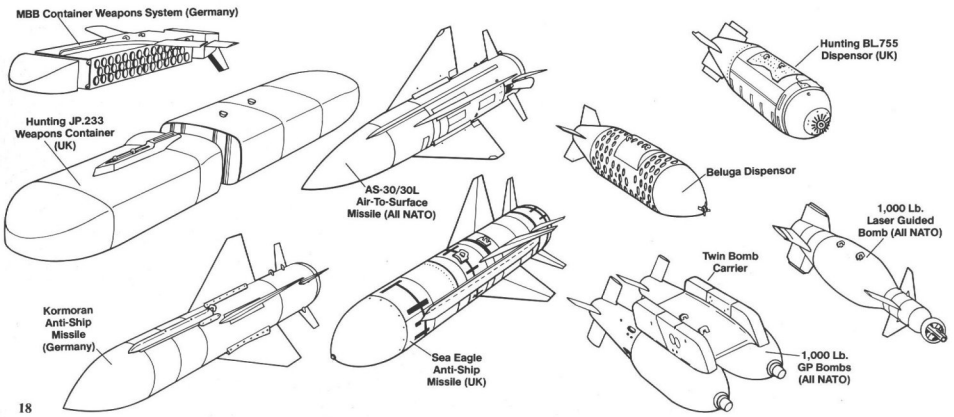
The Kormoran is normally carried on either the inboard wing pylons or the underfuselage pylons and, if necessary, missiles can be carried on all four weapons stations. On anti-shipping missions a pair of Ajax ECM pods are normally carried on the outboard wing pylons.

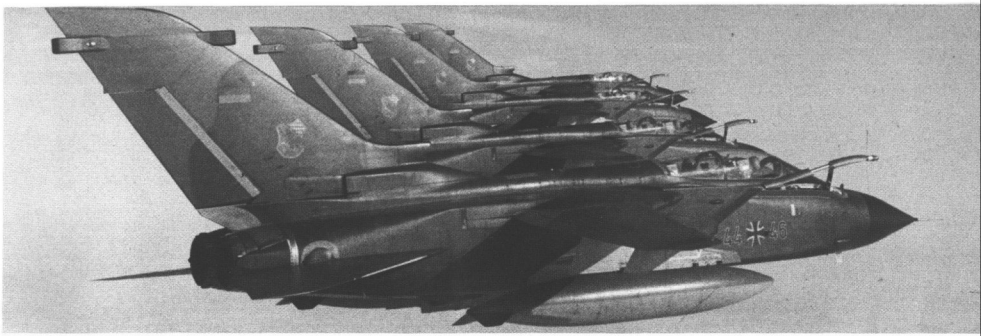


**This aircraft from JBG-38 carries a mixture of ECM and the MW-1 weapons dispenser as well as tanks. The underside of the port engine is still finished in Metallic Gray. (Panavia).**

A *Luftwaffe* Tornado IDS flies over the Grand Canyon during a visit to the U.S. *Luftwaffe* Tornados are becoming frequent visitors for exercises such as Red Flag. This aircraft, of JBG-31, carries a number of unit insignias from various USAF units on the fin. (Panavia)

## Tornado Weapons





Four aircraft of JBG-32 fly formation with their retractable refueling probes deployed. JBG-32 Tornados are based at Lechfeld, Germany. In wartime it is unlikely that Tornados would use formation tactics and most missions would be by single aircraft. (Panavia)

This Tornado, 45+12 of MFG-2, is carrying the new low visibility Germany Navy camouflage and markings. As with its sister unit, MFG-1, MFG-2 converted to the Tornado IDS from the Lockheed F-104G Starfighter. (Panavia)

A Tornado IDS (44+54) of JBG-32 flies a training mission armed with practice bomb carriers on the fuselage stations and a pair of underwing fuel tanks. The aircraft carries the newer *Luftwaffe* camouflage scheme while the tanks and pylons are in the old scheme. (Panavia)

A West German Navy Tornado IDS, 43+77 of MFG-1, flies over the Baltic Sea to the north of Germany. The aircraft is armed with a pair of Kormoran anti-ship missiles on the fuselage stations. MFG-1 is based at Schleswig-Jagel and would be tasked with anti-shipping strikes in the event of war. (Panavia)

This Tornado IDS is configured with 1,500 liter (396 gallon) drop tanks, a pair of Kormoran anti-sjip missiles, AIM-9 Sidewinder air-to-air missiles and ECM pods on the outboard wing pylons (Panavia)

A Navy Tornado, 43+77 of MFG-1, conducts a near vertical climb. The aircraft carries the standard anti-shipping armament of two Kormoran anti-ship missiles, along with drop tanks and defensive ECM pods. (Panavia).

# Italian Service

The *Aeronautica Militare Italiana* issued a requirement for some 100 Tornado IDS aircraft which were intended to replace both its Fiat G-91s and some of its F-104 Starfighters. Originally the Italians intended to maintain one operational squadron and keep the remaining aircraft on standby or in rotational maintenance. This plan would have entailed some fifty-four aircraft being kept in a state of readiness, but not deployed to an operational unit. The plan was later shelved and current Italian organization consists of three squadrons, each assigned to a different *Stormo* (Wing).

The Italian involvement in the three nation Tornado construction program consists of the manufacture of the wings which are built in Italy by Aeritalia. The first Italian prototype was P-05 (MM586), the fifth Tornado prototype to be built. It was delayed for a considerable time while problems involving the power plant were resolved, making its first flight on 5 December 1975. The aircraft flew for just over a month before it crash landed at Caselle. The Italians built one more prototype, P-09 (MM587) which was the first Tornado to launch a Kormoran anti-ship missile.

The first production deliveries to the *Aeronautica Militare Italiana* began during February of 1983, when 154 *Gruppo* (Squadron) formed as part of 6 *Stormo* (Wing) at Ghedi. The unit was formed as a weapons training unit with a secondary role as a frontline combat squadron. Its organization was similar to an RAF Operational Conversion Unit, including the use of a shadow squadron identity for use in time of national emergency.

A year later the next Tornado *Gruppo* was formed. 156 *Gruppo* was assigned to 36 *Stormo* with a number of seasoned crews transferring from 154 *Gruppo* to help form this first frontline combat unit. The squadron is based at Gioia del Colle with a primary role of Tactical Air Support of Maritime Operations (TASMO) over the Mediterranean Sea on the southern flank of NATO. Additionally, the squadron is trained to carry out overland close air support missions in support of land forces.

The third Squadron was 155 *Gruppo*, formed under 50 *Stormo* at Piacenza. 50 *Stormo* has the same TASMO and overland air support missions as 36 *Stormo* but also has the responsibility for the photo-reconnaissance using the Aeritalia/MBB tactical reconnaissance pod which is carried on the underfuselage centerline station.

In addition to its home based squadrons, the Italians also have ten aircraft based at RAF Cottesmore as part of the TTTE training program. These aircraft should be returning to Italy in the near future as the Italians will have filled their training requirements.

While the rest of NATO have adopted low visibility camouflage schemes for their Tornados, the Italians have retained the Metallic Gray undersurfaces and brightly colored squadron markings. Aircraft belonging to 26 *Stormo* have the large Red chevron with the squadron badge on the fin, while 36 *Stormo* carries a Yellow lightning bolt running through their squadron badge and 50 *Stormo* has three Blue triangles running back from the leading edge of the fin.

The Italians have also expressed a requirement for sixteen Tornado ECR aircraft and are considering conducting a Tornado mid-life update program similar to that being undertaken by the British.

**Three aircraft of 6 *Stormo* fly formation at low level over the Italian countryside. The aircraft carry their unit identification codes (G-05) on the nose in Black outlined in White. (Italian AF)**

Three Italian Air Force Tornados fly a training sortie over the Mediterranean Sea. One of the primary missions of the Italian Tornado fleet is maritime support for NATO ships operating in the Med. For this mission, they would be armed with Kormoran anti-ship missiles. (Italian AF)

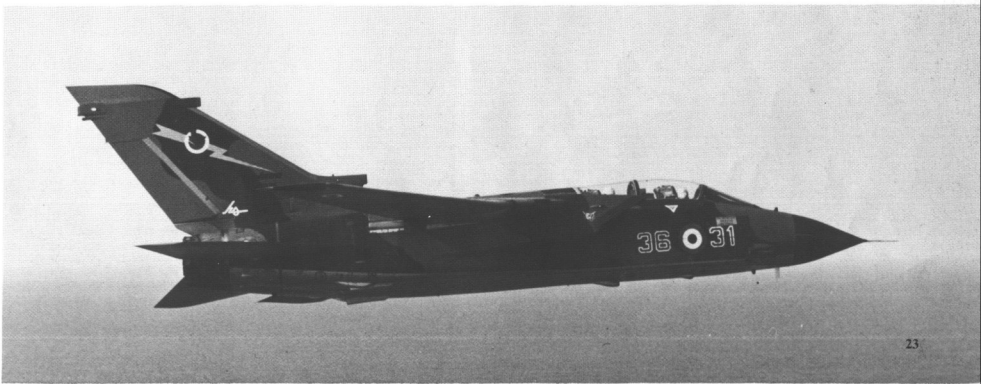
Tornado 6-06 refuels another Tornado (6-34) of 6 *Stormo* using a buddy-store refueling pod. While most Tornado users have opted for wraparound camouflage, the Italians have retained Metallic Gray undersurfaces on their Tornados. (Italian AF)

Three Tornado IDS aircraft of 36 *Stormo* fly formation over mountainous country. The two trailing aircraft are both carrying buddy-refueling stores on their underfuselage stations. The lightning flash through the unit badge is Yellow and just below that is the legend TORNADO in Black with the aircraft's serial number under it. (Italian AF)


This Tornado (36-31) of 36 *Stormo* carries an unusual insignia on the fuselage just behind the air intake. The small Yellow Tiger's head was probably acquired at one of the NATO Tiger fighter meets. (Panavia)


A Tornado IDS (36-34) of 36 *Stormo* carries the standard configuration for NATO maritime support: two drop tanks and a pair of Kormoran anti-ship missiles. Additionally, in time of war, ECM pods would probably be carried on the outer wing pylons. (Panavia).

36 *Stormo* is based in the southern part of Italy while the other two Italian Tornado squadrons are both based at Gioia del Colle. This aircraft has a Red air intake lining. (Italian AF)

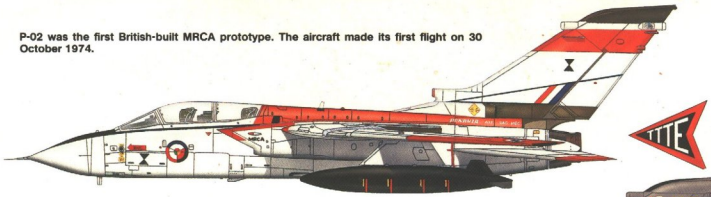


An Italian Air Force Tornado IDS passes over an Italian Navy frigate operating in the Mediterranean Sea. To control the sea lanes, the Torndao squadrons would have to cooperate closely with the Navy on sea control operations. (Italian AF)

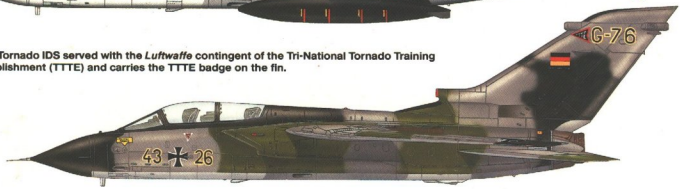
The center aircraft in this Tornado formation from 36 *Stormo* is armed with a pair of Kormoran missiles while the other two aircraft carry buddy-store refueling pods on the under stations. (Italian AF).

A Tornado IDS (36-31) of 36 *Stormo* flies past an ancient Italian fortress. Individual Italian units can be easily identified since the *Stormo* number is part of the aircraft identification number on the nose. (Panavia)

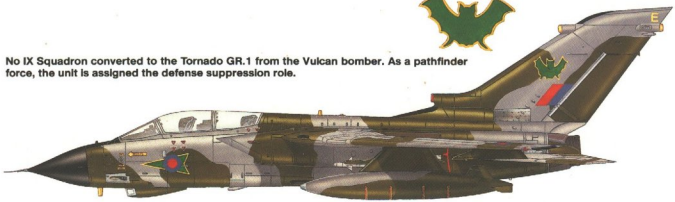
P-02 was the first British-built MRCA prototype. The aircraft made its first flight on 30 October 1974.



This Tornado IDS served with the *Luftwaffe* contingent of the Tri-National Tornado Training Establishment (TTTE) and carries the TTTE badge on the fin.




No IX Squadron converted to the Tornado GR.1 from the Vulcan bomber. As a pathfinder force, the unit is assigned the defense suppression role.

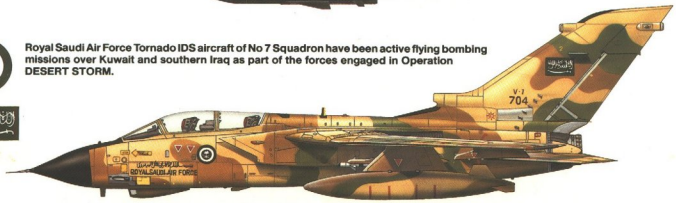


This colorful Tornado GR.1 serves with the Royal Aerospace Establishment (RAE) for use in a number of research projects.


A Tornado IDS of 154 *Gruppo*, Italian Air Force. Italian Tornados mainly serve in the maritime support role.

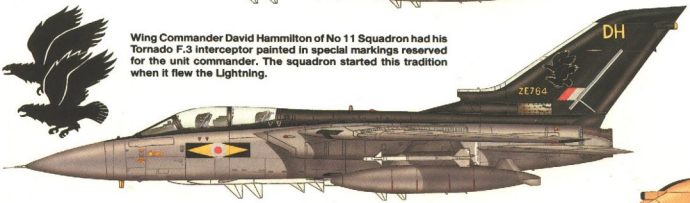
This Tornado IDS of the West German Navy is armed with a pair of Kormoran anti-ship missiles on the fuselage pylons.


Royal Saudi Air Force Tornado IDS aircraft of No 7 Squadron have been active flying bombing missions over Kuwait and southern Iraq as part of the forces engaged in Operation DESERT STORM.




A late production Tornado F.2 of No 229 Operational Conversion Unit (OCU). No 229 OCU was the only unit to fly the Tornado F.2.


Wing Commander David Hammilton of No 11 Squadron had his Tornado F.3 interceptor painted in special markings reserved for the unit commander. The squadron started this tradition when it flew the Lightning.




Tornado GR.1s in service with No 14 (Composite) Squadron in Saudi Arabia were repainted in a special sand camouflage known as Desert Pink. The Tornados have seen combat as part of the allied forces in Operation DESERT STORM.

# Tornado ADV/F.2

During 1976, the British Government announced that it would develop and deploy a dedicated Air Defense Variant (ADV) of the Tornado, with a requirement for at least 165 aircraft. These aircraft were intended to replace both the ageing Lightning fleet that had been in service since 1960 and the F-4 Phantoms that have served since the end of the 1960s.

The Lightning was the fastest aircraft ever to serve with the RAF but it had one major drawback: its loiter time was extremely limited. Additionally, it carried a somewhat outdated weapons system. Its endurance could be improved by carrying overwing fuel tanks; however, with the tanks in place, the maneuverability suffered. The F-4, which is without doubt the most successful combat aircraft produced in the West, was showing its age when compared to the new fighters entering service such as the F-14 Tomcat and F-15 Eagle.

When Britain announced its intention to build the Tornado ADV, the U.S. Government offered the RAF both the F-15 (at a reduced price) and, following the fall of the Shah of Iran, a number of F-14s were offered at a knock down price. Both were rejected due to cost and because British industry was determined to make the Tornado ADV (now known as the Tornado F.2) a success. From the beginning, the Tornado F.2 was not intended to be a dogfighter capable of tangling with enemy fighters such as MiGs, but an interceptor designed to engage bomber formations over the North Atlantic.

After the engineering mock-ups were built and approved, the first prototype (ZA254) was rolled out during May of 1979, still in its primer finish. The Torando F.2 differs from the GR.1 in having a longer nose and larger more pointed radome, housing the Foxhunter air intercept radar (the F.2 is four feet five inches longer than the GR.1). The F.2 has four staggered semi-recessed missile bays under the fuselage for Sky Flash radar guided air-to-air missiles and has a single 27MM cannon on the starboard side (the port cannon was deleted to make room for additional avionics). The F.2 lacks the outboard underwing pylons carried on the GR.1. Power was supplied by the same Turbo-Union RB199-34R engine as the GR.1.

British Aerospace (BAe) built three prototypes (rebuilt from Tornado GR.1 airframes). The first prototype made its first flight on 9 August 1979, followed by the first dual control ADV trainer (ZA267) on 18 July 1980. After early testing at Warton these aircraft were transferred to A&AEE for pre-service trials. These two aircraft were joined by the final prototype (ZA283) during November of 1980.

Airframe and engine tests progressed well; however, problems were encountered with the AI radar. The AI-24 Foxhunter radar was being developed jointly by Marconi Avionics and Ferranti. The radar was to have a look down/shoot down capability at ranges up to 115 miles, and the capability to track between twelve and twenty possible targets while maintaining a continuous scan. Unfortunately, the Foxhunter was some four years behind schedule when the Tornado F.2 was ready to enter service.

This delay, along with commitments to the air defense of the Falkland Islands, meant

**The first prototype Tornado Air Defense Variant (ADV) was rolled out at Warton during May of 1979 still in its primer finish. The aircraft differed from the GR.1 in having a longer radome and provision for four Sky Flash missiles on the fuselage underside. (BAe)**

that the RAF had to purchase a number of ex-US Navy F-4Js and reform No 74 Squadron. Additionally, because of the delay with the radar unit, the first production Tornado F.2s entered service with concrete ballast in the nose instead of a radar set.

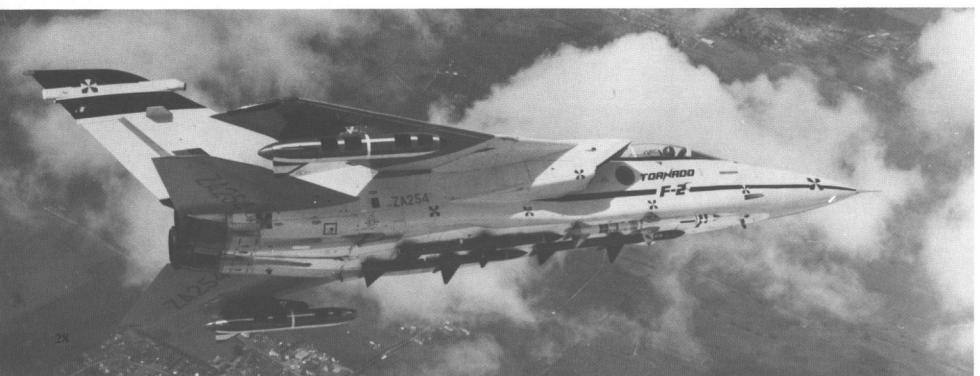
The first production batch of F.2s consisted of eighteen aircraft, all but the first two being delivered to No 229 Operational Conversion Unit at Coningsby in Lincolnshire. The first two aircraft went to A&AEE for further testing and development work. In the event, these were to be the only Tornado F.2s built, since a decision had been made to re-engine the aircraft with a more powerful Mk 103 engine. Of the eighteen Tornado F.2 produced, eight were configured as dual control trainers.

On 1 November 1984, No 229 Operational Conversion Unit was formed at RAF Coningsby, with the first two Tornado F.2s assigned to the unit arriving four days later. The F.2s were finished in a low visibility overall Light Gray camouflage. No 229 OCU is unique in that it was the only RAF unit to be equipped with the Tornado F.2.

Originally, No 229 OCU adopted a unit badge consisting of a crossed torch and sword carried on the fin above the fin flash. The nose markings consisted of a Red and Yellow flash on the nose. These markings were similar, but larger, to those carried by the Hawks of the Tactical Weapons Unit (TWU). The OCU changed their nose markings after they were given their wartime shadow squadron identity.

In December of 1986 the OCU was declared combat ready for the emergency air defense roles. As part of this mission, the unit was given a formal first line squadron identity (shadow identity) for use under operational circumstances. This shadow squadron designation was No 65 Squadron and accordingly new unit markings were applied to the nose of the unit's F.2s. These markings comprised a Black rampant Lion in a White disc flanked by Red and White chevrons.

**In full afterburner, the Tornado F.2 prototype lifts off the Farnborough runway at the beginning of one of its demonstration flights. The aircraft was configured with dummy missiles and underwing fuel tanks. (Author)**

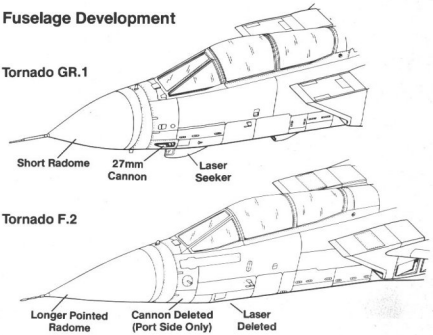


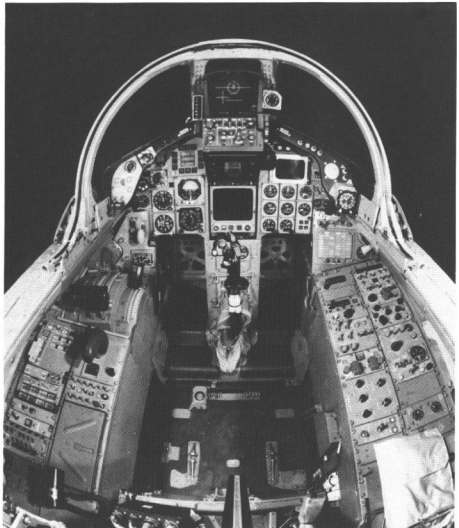

**The first Tornado ADV prototype (ZA254) conducts an early test flight carrying dummy Skyflash missiles and ECM pods on the outboard wing pylons. Normally these outboard wing pylons are not fitted. (MoD)**

ZA283 was the third prototype ADV built and the first to carry the air superiority overall Light Gray camouflage. Early Torndao ADV prototypes had a camera mounted in the forward fin tip ECM fairing. (MoD)

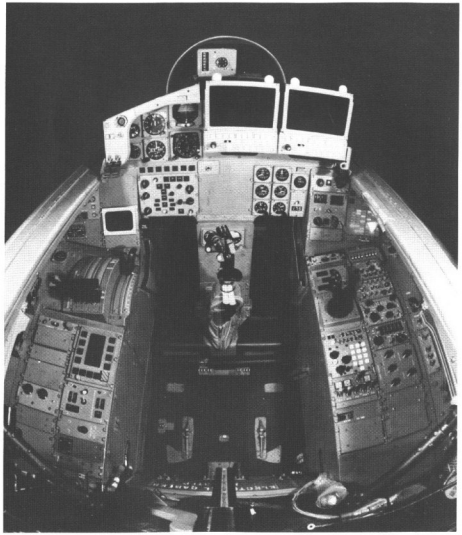
During the 1982 Farnborough air show the Torndao ADV was demonstrated. Prototype ZA254 was repainted for the show and carried the aircraft's new designation, Tornado F.2, on the fuselage. (Author)


## Fuselage Development





The front cockpit of the Tornado F.2 contains both standard gauge type instruments as well as video displays. In the center of the windshield is the pilot's head-up display, below it are the head-down display and weapons control panel. (BAe)

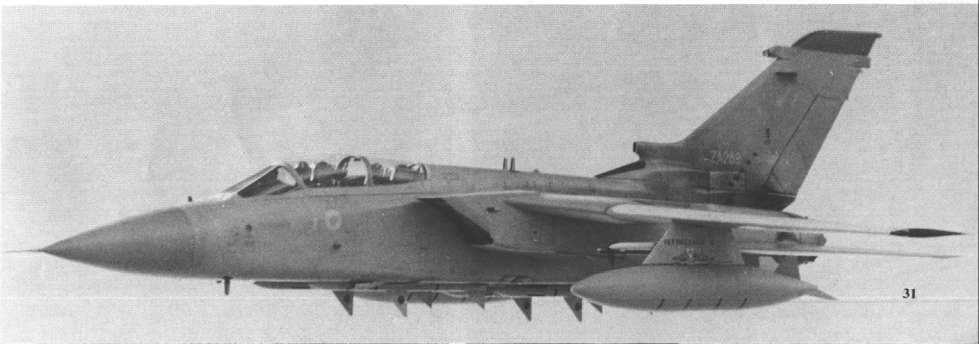


The rear cockpit of the Tornado F.2 (T) is manned by a weapons systems officer. The video displays are for radar and weapons information (a number of sensitive panels were covered for security). The control stick and throttle identify this aircraft as a dual control F.2 (T). (BAe)

An early production Tornado F.2 makes a low pass over one of Britain's North Sea oil rigs. Protection of the North Sea oil fields was one of the primary reasons for the development of the Tornado ADV. (Panavia)

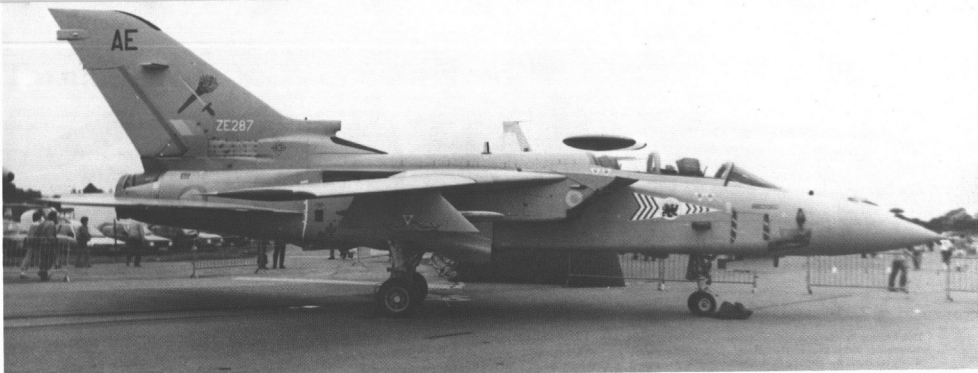
Nine Tornado F.2s of No 229 OCU conduct a practice formation flyby. No 229 OCU was the only RAF unit to operate the Tornado F.2. There were a total of eighteen F.2s built and all are currently in storage at RAF St Athan. (MoD)

The third Tornado F.2 prototype (ZA283) conducts a test flight loaded with two 1,500 liter (396 gallon) underwing fuel tanks and four dummy Skyflash missiles. The rails on the inboard side of the underwing pylon are for AIM-9 Sidewinder infrared air-to-air missiles. (MoD)



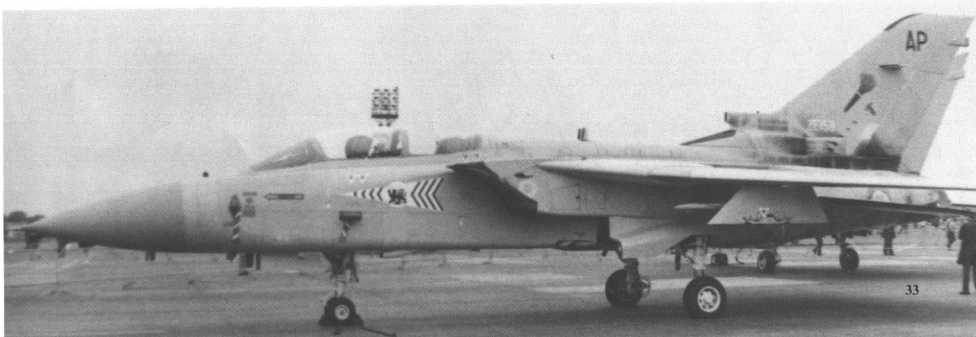
Twelve Tornado F.2s of No 229 Operational Conversion Unit parked on the flight line of RAF Coningsby, Lincolnshire. RAF Coningsby was the first base to receive the Tornado F.2, followed by Leeming in North Yorkshire. (MoD)

This Tornado F.2 carries two AIM-9L Sidewinders on the underwing pylons. The Sidewinder is an American designed all aspect infrared homing air-to-air missile which is built in Europe under license. The aircraft carries an overall Light Gray camouflage with low visibility national insignia. (MoD).




A Tornado fighter is prepared for static display at RAF Fairford. With the new (No 65 Squadron) nose markings, the national insignia was moved from the nose to the forward edge of the air intake. (Author).

During 1986, No 229 OCU changed their markings reflecting their wartime role as an operational fighter squadron (No 65 Squadron). The new unit markings consisted of a Red and White arrow with No 65 Squadron's Black Lion in the center. (Author)



This Tornado fighter has a number of "Remove before flight" tags and protective covers over the sensors and probes on the fuselage side. Beginning in mid-1986 the Tornado F.2s were slowly replaced by Tornado F.3s and the F.2s were retired. (Author)

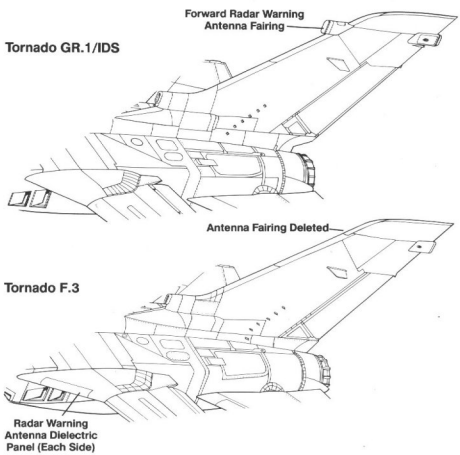
This Tornado F.2 (ZD932) of No 229 Operational Conversion Unit (OCU) took part in the 1985 Mildenhall air show. This show was one of the first public appearances of the Tornado F.2. (Author)

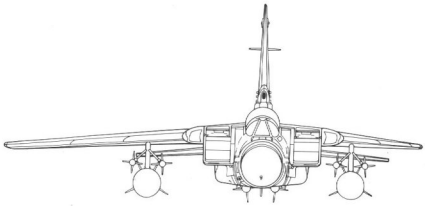
# Tornado F.3

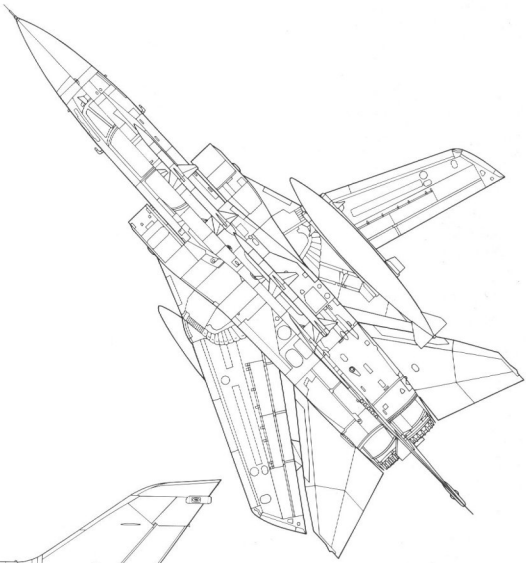

A pair of Tornado F.3s of No 29 Squadron conduct a training flight over a thick blanket of cloud, typical for a British summer day. The Tornado F.3 is an all weather fighter and No 29 Squadron is one of Britain's longest serving fighter squadrons dating back to the First World War. (MoD)

A Tornado F.3 (ZE258) of No 29 Squadron on final approach to RAF Coningsby. No 29 Squadron was the first frontline F.3 squadron formed by the RAF. The Tornado replaced the F-4 Phantom FGR.2 when the squadron returned from RAF Stanley in the Falklands. (Author).


## Fin Development







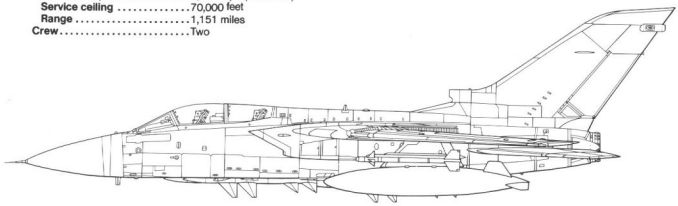
## Specifications

## British Aerospace Tornado F.3

**Wingspan** .....45 feet 7.5 inches
**Length** .....59 feet 3.9 inches
**Height** .....19 feet 6.25 inches
**Empty Weight** .....31,970 pounds
**Maximum Weight** .....61,700 pounds
**Powerplant** .....Two 18,800 lbst Turbo-Union RB199-34R Mk 104 turbofan engines.

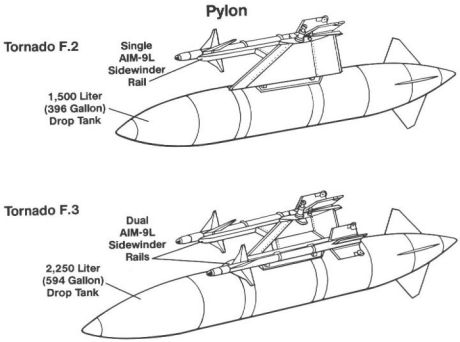
**Armament** .....One 27MM cannon
Four Sky Flash radar AAMs and four AIM-9L Sidewinder infrared AAMs.

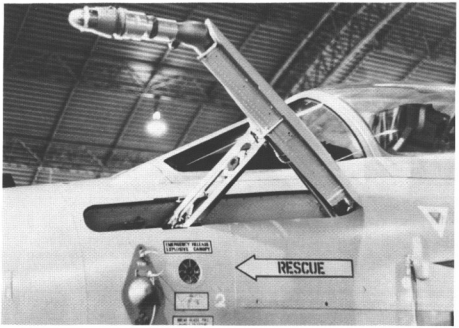
**Performance**
**Maximum Speed** .....1,650 mph (Mach 2.2)
**Service ceiling** .....70,000 feet
**Range** .....1,151 miles
**Crew** .....Two



Unlike other Tornado F.3 fighter units, No 29 Squadron's unit markings are not applied to either side of the nose roundel but rather on the air intake lip. The insignia colors are Red outlined in Yellow. (MoD)

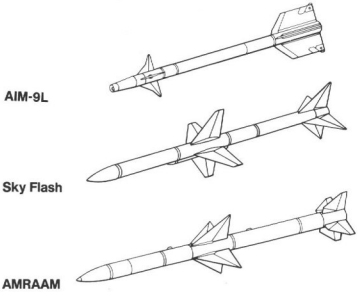
The second RAF frontline squadron to receive the Tornado F.3 was No.5. Squadron based at RAF Coningsby. The squadron markings consist of a Red band on the tail with a Green maple leaf on a White disk and a Red arrow on the nose with the same maple leaf insignia superimposed on it. (Author)

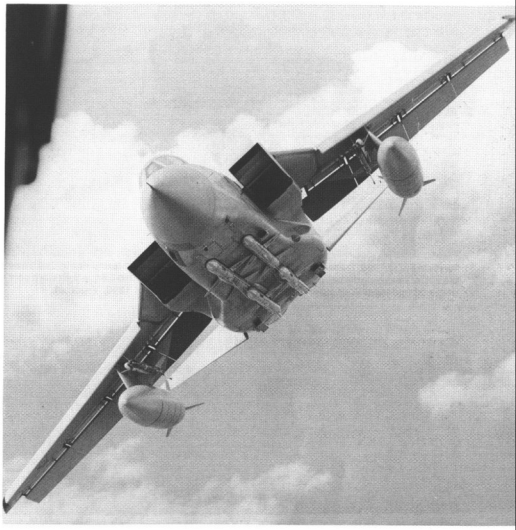




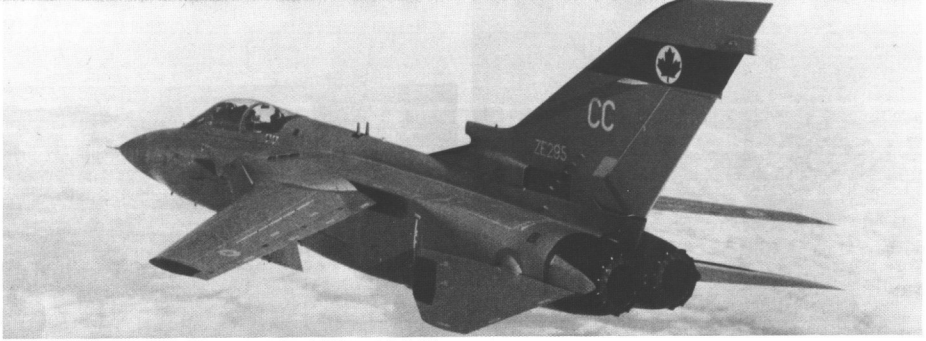

The Tornado F.3 replaced the external refueling probe of the GR.1/IDS variant with a fully retractable probe mounted on the port side. (Author)

## Tornado F.3 Weapons



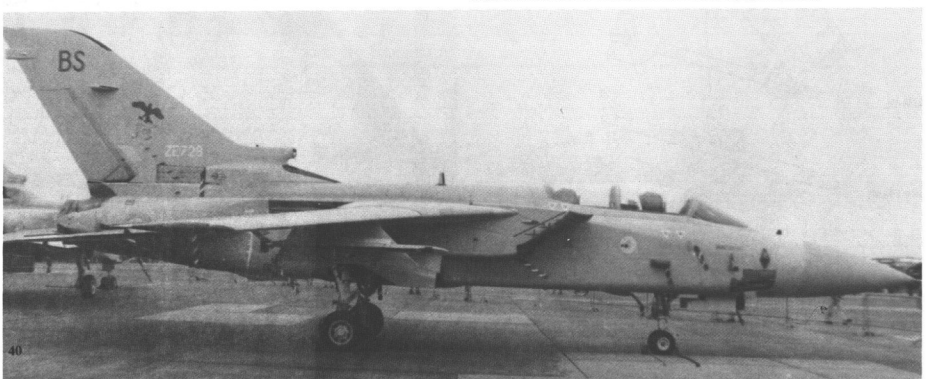



This Tornado fighter has the wings full forward and the trailing edge flaps down indicating it is flying at a very slow airspeed. The aircraft is carrying four Skyflash and two Sidewinder missiles and a pair of underwing drop tanks. (MoD)




Tornado F.3 (ZE295) is assigned to No 5 Squadron. This Tornado F.3 is unusual in that it has the upper wing roundel painted on the trailing edge flaps. F.3s from No 5 Squadron were part of the composite unit deployed to Saudi Arabia during August of 1990. (Panavia).

A Tornado F.3 (ZE728) of No 29 Squadron on the ramp at RAF Coningsby during the station's open house held in 1988. One of the external differences between the F.2 and F.3 is the outboard AIM-9 Sidewinder missile rail on the underwing pylon. (Author).



This Tornado F.3 interceptor, parked outside a Hardened Aircraft Shelter (HAS) is assigned to No 23 Squadron. The nose markings are Dark Blue and Red and the Bird on the fin is in Red. (Mark Gray)

No 11 Squadron commander, Wing Commander David Hammilton, had his personal Tornado F.3 painted with a Black fin. This special scheme carried on a tradition that was started when the unit still flew Lightning fighters. (Mark Gray)

A Tornado F.3 (ZE784) of No 11 Squadron flies formation with a pair of Lightning F.6 fighters just before the Lightning was retired from RAF service. The Tornado F.3 replaced the Lightning in the RAF's interceptor squadrons. (FLT LT I. Black).

# Exports

## Royal Saudi Air Force (RSAF)

For many years Britain has had trade links with Saudi Arabia and during February of 1986 the two governments signed a contract for forty-eight Tornado IDS variants and twenty-four Tornado F.3 air defense variants. This contract became known as the *Al Yamamah* program. Within a short period, the Saudis amended the contract, increasing it by another forty-eight aircraft: twenty-four Tornado IDS and twenty-four Tornado F.3s. This contract was named the *Al Yamamah* Phase Two program and it included some sixty BAe Hawk jet trainers, some of which are reportedly to be the Hawk 200 single seat fighter variant.

To meet Saudi delivery requirements, twenty Tornado GR.1s (including four dual control GR.1T aircraft) were diverted from the RAF production contract for immediate delivery to the Royal Saudi Air Force (RSAF). The first of these aircraft was handed over to the RSAF during March of 1986.

Royal Saudi Air Force crews were trained by the RAF at the TTTE and a number of Royal Air Force advisors were stationed in Saudi Arabia to assist in the training or RSAF crews. The first four Saudi crews to complete training graduated the Tornado Weapons Conversion Unit on 28 March 1986. These were followed by another four crews who graduated in May of 1986. These men returned to Saudi Arabia to serve as instructors for the RASF Tornado training course. Since the RSAF has never operated two seat jet attack aircraft, there was no pool of "back seaters" to draw from. As a result, most RSAF Weapons Systems Officers (WSOs) are ex-fighter pilots.

The first RSAF squadron to convert to the Tornado IDS was No 7 Squadron (formerly an F-5E Tiger II squadron) at Dhahran. The Tornados delivered to the RSAF carry a wrap around desert camouflage scheme of Dark Green, Brown and Sand. Since the Iraqi invasion of Kuwait, the squadron has been moved from Dhahran to Taif Air Base to make room at Dhahran for USAF F-15s and RAF Tornados.

The second Tornado IDS squadron is No 66 Squadron which is due to form during early 1991 at a yet unspecified air base. The unit is allocated twenty-four aircraft, including an unspecified number of dual control and reconnaissance configured aircraft.

Besides the two IDS units, there are two Tornado F.3 interceptor squadrons, Nos 29 and 34 Squadrons, each with twelve aircraft and based at Dhahran. No 29 received its first aircraft during February of 1989 while No 34 Squadron was formed at Dhahran during November of 1989. It is planned that the two squadrons would operate alongside the RSAF F-15s under the control of RSAF E-3 aircraft. As with RAF Tornado F.3s, the RSAF aircraft carry an overall air superiority Gray camouflage.

No 29 Squadron Tornados stand twenty-four hour alert duty at Dhahran Air Base and are kept under sun shade type shelters to provide the crews with some relief from the desert sun. Combat air patrols are flown along the Saudi/Iraqi border and along the Saudi/Kuwaiti border. It is known that RSAF Tornados have made radar contact with Iraqi fighters, but no engagements have been reported.

While armed with British designed and built Sky Flash radar guided missiles, the Saudi F.3s will not carry European built Sidewinder infrared homing missiles. The RSAF already has a large inventory of American-built AIM-9P and AIM-9L Sidewinders that were delivered as part of the armament packages for the F-5 and F-15 programs.

**A pair of No 7 Squadron Tornado IDS aircraft make a low pass over a city in Saudi Arabia. The RSAF legend on the nose is in Green (the color of Islam) and the aircraft serial number (704) is in both English and Arabic style numbering on the fin. (RSAF)**

**A pair of Royal Saudi Air Force Tornado GR.1s of No 7 Squadron conduct a low level training flight. The RSAF was the first export user of the Tornado and No 7 Squadron aircraft have been active in low level bombing attacks against Iraqi targets. (RSAF)**

# Other Tornado Exports

British Aerospace is extremely fortunate in that they can offer any potential export customer both a strike and interceptor version of the same basic aircraft.

When the Tornado was first unveiled, Australia and Canada both expressed interest in the aircraft, although both opted to purchase the F/A-18 Hornet. At the time, the Canadians stressed that it was only the unit price that stopped them from buying the Tornado IDS.

Other Middle East orders were placed by Oman and Jordan. The Omani order was for eight Tornado F.3s while Jordan had a requirement for eight Tornado IDS aircraft. In the event, both nations cancelled their orders due to financial constraints.

In the latter half of 1988 a pair of Tornado F.3s from No 29 Squadron departed on an around the world demonstration and sales tour. They visited Singapore, Malaysia, Thailand and Australia. On 27 September 1988 a preliminary contract was signed with Malaysia for twelve Tornado IDS aircraft. This was later cancelled when the two governments could not agree on costs and other details.

At the present time both BAe and Germany's MBB are offering Tornados to South Korea (which has a requirement for forty ECR variants). This contract is still in the early stages with no firm commitment. Thailand has also expressed an interest for twelve Tornado IDS and four ECR variants.

Rockwell has been appointed the US partner in an effort to sell a modified Tornado ECR variant to the USAF as a Follow On Wild Weasel aircraft to replace the F-4G Phantom. Rockwell would be responsible for the installation of U.S. avionics in the Tornado airframe, other modifications necessary to meet the Wild Weasel mission and final assembly of the aircraft at Palmdale, California. As of early 1991, the project was still in the concept stage with no decision expected for the near future.

**An RSAF Tornado IDS lifts off on a training sortie in full afterburner. The aircraft is carrying two 1,500 liter (396 gallon) underwing fuel tanks. RSAF camouflage is Sand, Brown and Green uppersurfaces over Light Gray undersurfaces. (RSAF)**

# Gulf War
## Operation GRANBY and Operation DESERT SHIELD

On 2 August, Iraqi land forces, backed by air support, invaded the small country of Kuwait. Within hours, the Kuwaiti armed forces were overrun. The small Kuwaiti Air Force lost a number of its Mirage F.1 fighters to Iraqi artillery with the survivors retreating to Saudi Arabia and Bahrain. KAF A-4KU Skyhawks operated from a highway after their base was rendered unserviceable, destroying a number of Iraqi helicopters before the A-4 also sought safe haven in Saudi Arabia. Soon more than 100,000 Iraqi troops were massed along the Kuwait/Saudi border. Faced with the very real possibility of an Iraqi invasion, the King of Saudi Arabia requested military assistance from the United States and the United Nations.

On 9 August 1990, the British Defense Secretary, Tom King, authorized the deployment of Royal Air Force (RAF) Tornado GR.1s and Tornado F.3s to Bahrain and Saudi Arabia under the code name Operation GRANBY. These aircraft were to operate alongside Royal Saudi Air Force (RSAF) Tornado units. The initial deployments were made up of Tornado F.3s of No 29 and No 5 Squadrons which were already on Cyprus for armament training. These aircraft deployed to Dhahran Air Base, Saudi Arabia on 12 August to operate alongside RSAF F.3s (No 29 Squadron) and USAF F-15Cs (1st Tactical Fighter Wing). To coordinate operations, the Tornado detachment was formed into a new unit, known as No 5 (Composite) Squadron. The deploying F.3s were modified with AN/ALE-40 chaff/flare dispensers installed under the rear fuselage.

Since the first part of the Allied buildup in Saudi Arabia was centered around air defense, No 5 Squadron Tornado F.3s were soon active in flying Combat Air Patrol (CAP) missions with RSAF Tornado F.3s and USAF F-15Cs. All three services operated under the tactical control of USAF and RSAF E-3 Sentry AWACS aircraft. The RAF contingent, known as the British Forces Arabian Peninsula, was stationed in Saudi Arabia, Bahrain and Oman under the command of Air Vice Marshal Sandy Wilson, while the composite F.3 unit was commanded by Wing Commander Euan Black. Wing Commander Black reported that during the early buildup, RAF Tornado F.3s made radar contact with Iraqi Air Force fighters; however, none crossed into Saudi airspace and no engagements took place. The CAPs were maintained on an around-the-clock basis and, reportedly, aircraft availability was nearly ninety percent.

The first Tornado GR.1s deployed to the Gulf came from RAF Germany. Prior to deployment from RAF Bruggen, ground crews repainted the Tornados with a special desert camouflage known as Desert Pink. The aircraft had all national insignia removed, carrying only rescue markings and the aircraft identification letters on the fin. On Sunday, 26 August, an advance party left Bruggen for Bahrain. This party was followed a day later by the Tornados. The aircraft departed the base in flights of four, with the first being led by the squadron commander, Wing Commander Vaughan Morris. The deploying GR.1s were drawn from Nos 9 (four), 14 (four) and 31 (four) Squadrons in Germany along with an additional twelve aircraft drawn from Nos 15 (four), 16 (four) and 20 (four) Squadrons in England. These were backed up by additional Tornado F.3s drawn from No 11 Squadron. These aircraft became the RAF contingent of Operation DESERT SHIELD established during early August.

As part of the Italian commitment to Operation DESERT SHIELD, eight Tornado IDS aircraft were deployed to the Gulf. These aircraft were drawn from No 6 *Stormo*, No 36 *Stormo* and No 50 *Stormo*. The Italian contingent was based at Al Dhafra in the United Arab Emirates (UAE). Before deploying to the Gulf, the Tornados were repainted in a special desert Sand Yellow camouflage at Cameri, Italy.

## Operation DESERT STORM

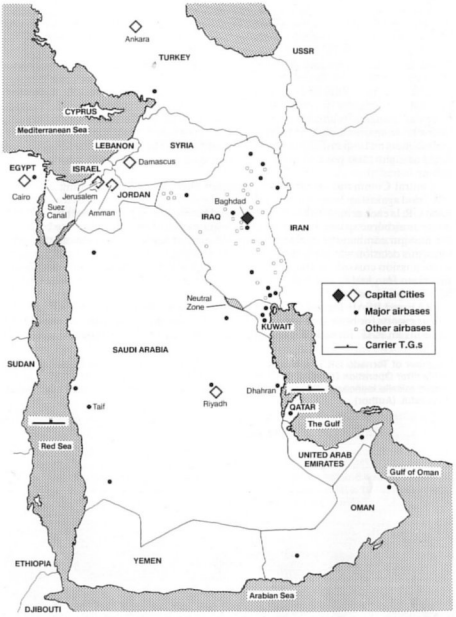
At 0300 on 16 January 1991, all the low-level training and practice was put to the test as RAF and RSAF Tornados joined USAF, USN, USMC, RSAF, and Kuwait AF aircraft in attacking selected military targets in both Iraq and Kuwait as part of Operation DESERT STORM. Initial reports from the RSAF and RAF indicated that all aircraft returned safely to base after the first raids.

RAF targets during the opening attacks were primarily Iraqi airfields. For these missions, it is believed that the Tornados were armed with JP223 area denial weapons and/or Hunting BL755 cluster bombs. During the attack missions, RAF and RSAF Tornado F.3s flew top cover for the strike aircraft. One No 31 Squadron pilot later stated that the Tornado crews, "pushed it as low as we dared." He reported that they found and attacked their airfield target, "like we were on rails." On 17 January, one RAF Tornado GR.1 was lost due to an engine fire that was believed to have been started by ground fire. The crew ejected safely and the Iraqis later revealed that the crew (from No 15 Squadron) had been captured and were being held as POWs.

As the raids continued, the RAF lost a second Tornado GR.1 on 18 January. On that same day, Italian Air Force Tornados joined the bombing effort and one of these aircraft was also lost to ground fire, possibly a surface-to-air missile. The crew successfully ejected and the Iraqis listed one of these men as a POW.

On Saturday, 19 January, British Defense Minister King revealed that an unspecified number (believed to be four) of Tornado GR.1A reconnaissance aircraft from No 13 Squadron had been deployed to the Gulf and had seen action in the hunt for mobile Iraqi SCUD surface-to-surface missile launchers. At least one such mobile unit was reportedly located and a GR.1A had recorded a SCUD launch on video. Upon detecting the launch, the GR.1A crew was able to direct strike Tornados to the target, destroying the launcher unit. During these strikes, RAF Tornados employed a new weapon, the BAe Alarm anti-radiation missile. This weapon is similar to the U.S. HARM and Standard ARM missiles being used against enemy radar sites.

**This Tornado GR.1 of No 15 Squadron was repainted in a special camouflage finish known as Desert Pink for operations in Saudi Arabia. Four No 15 Squadron aircraft deployed to the desert as part of Operation GRANBY. (Author)**




By 22 January, the RAF had flown some 400 combat sorties and had lost an average of one aircraft per 100 sorties. Total Tornado losses were as follows: four RAF GR.1s (one due to mechanical failure), one Italian IDS and one RSAF Tornado IDS. Additionally, at least one RAF GR.1A was slightly damaged by ground fire. Although, Tornado losses were proportionately higher than losses suffered by the other air forces in Operation DESERT STORM, these losses were considered as very light by senior RAF officials, especially when considering the extremely low altitude of Tornado operations and the fact that most bombing missions were being flown at night. Air Vice Marshal Bill Wratton stated that the tactics of the Tornado units were being evaluated in light of their losses, however, he also stated that the weapon favored for airfield attacks was the JP223 weapons container/dispenser and that this weapon required a low-level delivery to be effective.

Besides the RAF and Italy, Tornado bombing missions were also flown by the RSAF Tornado fleet, although most of these missions were being flown in either Kuwait or southern Iraq. Flying top cover for these raids were RSAF F-15s and Tornado F.3s. One F.3 pilot was LTCOL (Prince) Abdallah bin Khalid of the Saudi Royal Family. He stated that he had been surprised by the lack of Iraqi air opposition and was happy to be working with the British and Americans.

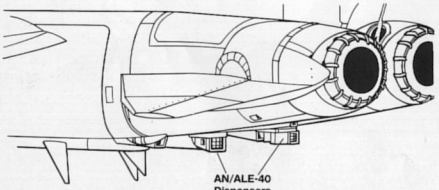
British aircrews also began putting names, cartoon characters and written messages on their aircraft. One Desert Pink Tornado GR.1 was noted with the inscription *HELLO KUWAIT G'BYE IRAQ* on the fuselage side below the cockpit in Black. Another Tornado was noted with a sharkmouth marking on the nose just behind the radome. The sharkmouth was not in the usual Red and White, but rather in subdued colors (believed to be shades of Tan) against the Desert Pink camouflage. A number of Tornados and Jaguars have been noted carrying pinup girls painted on the fuselage sides just below and in front of the cockpit. Several Tornados have been seen with the world famous Snoopy cartoon character riding a bomb or missile painted on the starboard fuselage below the cockpit.

**The aircraft repainted for Operation GRANBY carried no national insignia. The sole identification was the aircraft code letters carried on the fin in a White outline style against the Desert Pink camouflage. (Author)**

**The first Tornados to deploy to Saudi Arabia were Tornado F.3 interceptors. The RAF F.3s flew combat air patrol over the desert along side RSAF F-15s and Tornado F.3s. The RAF aircraft were modified with chaff/flare launchers mounted under the engine nacelles. (MoD)**

## AN/ALE-40 Chaff/Flare Dispensers

**Tornado F.3**




Additionally, Jaguar fighter-bombers were noted carrying mission markings (small Black bombs) on the fuselage sides in front of the air intake. One Desert Pink Victor tanker was noted with four Black gas station pump symbols on the fuselage side for the refueling mission it had flown in support of British fighter-bombers.

On 23 January, a seventh air force joined the bombing campaign when the Quatar Air Force sent Mirage F.1s and Alpha Jets to attack targets in Kuwait. Iraq also announced that it was now holding a total of three British airmen as POWs, leaving three crewmen listed as missing in action. A senior RAF spokesman revealed that the Tornado force was changing its target priority and weapons loads. The Tornados were continuing their attacks against mobile SCUD launchers, but were also attacking the hardened aircraft shelters on Iraqi airfields with 1,000 pound bombs. The load for these missions consisted of eight 1,000 pound bombs carried on dual bomb racks on the underfuselage pylons.

Central Command briefer, Group Captain Niall Irving, in describing a Tornado GR.1 raid against an Iraqi airfield, stated that the strike force was comprised of eight Tornado GR.1s each armed with eight 1,000 pound bombs, with an additional two Tornados along as airborne spares. Normally, the two spares would be free to return to base once the mission commander decided all mission aircraft would be completing the sortie. Once this decision was made the commander would release the spares (usually after the strike mission crossed the Iraqi border). On this mission, the two spares elected to continue into Iraq and to attack the squadron's alternate target, rather than return to base with full bomb racks.

RAF and RSAF Tornado F.3s were used throughout the conflict for CAP missions and as escorts for both Tornado and Jaguar strike aircraft. Reportedly, on one of these missions an RAF Tornado F.3 engaged and destroyed an Iraqi MiG-23 Flogger.

**A number of Tornado GR.1As, like this aircraft of No 13 Squadron, were rushed to Saudi Arabia after Operation DESERT STORM began to assist in locating Iraqi SCUD surface-to-surface missile launchers. Recent reports indicate the Tornado GR.1As have been highly successful. (Author)**

A Tornado F.3 escorts a pair of Tornado GR.1s over the Saudi desert. While the F.3 carries normal national insignia consisting of low visibility roundels and fin flash, the GR.1s carry only the individual aircraft code on the fin and standard rescue markings on the fuselage side. (MoD)

A pair of Royal Saudi Air Force Tornado IDS aircraft low over the desert near their home base. RSAF Tornados have seen action alongside the Tornado GR.1s of the RAF and the Tornado IDS aircraft of the Italian Air Force in missions against Iraqi targets. (Panavia)

A Tornado GR.1 skims low over the Saudi desert enroute to its base in Bahrain after a successful mission against Iraqi forces in Kuwait. RAF Tornados have been active flying bombing missions against Iraqi targets since the very beginning of Operation DESERT STORM. (MoD)

While one Jaguar fighter-bomber refuels from a VC-10 tanker of No 101 Squadron, two others and a Tornado GR.1 wait their turns. Besides the VC-10s, it is known that a number of Victor tankers of No 55 Squadron have also deployed to the Gulf to support the bombing effort. (MoD)

Sharing the bombing effort in Kuwait with the Tornados, Jaguar GR.1s of Nos 6 and 41 Squadrons first arrived in Bahrain on 18 August 1990. The Jaguar force has been active in day-light bombing of targets in both Kuwait and southern Iraq. (MoD)

Most Tornado GR.1 missions are flown at extremely low altitudes — at night! Because they fly at such low level, the Tornados draw heavy ground fire and at least three Tornados are known to have been lost to anti-aircraft artillery fire while attacking Iraqi airfields. (MoD)

A pair of Jaguar GR.1s refuel from a VC-10 Tanker over Saudi Arabia. The RAF contingent in the Gulf region consists of Tornado GR.1s, Tornado F.3s, Jaguar GR.1s, Victor and VC-10 tankers and, most recently, a number of Buccaneer strike fighters. (MoD)

RAF Puma HC.1 helicopters share the ramp at a Saudi airfield with U.S. Marine Corps AH-1W Sea Cobras. Search and rescue operations, troop and supply movements and other support missions for the Tornado and Jaguar strike force are performed by the Puma HC.1s of No 230 Squadron. (MoD)

# AIRCRAFT OF THE GULF WAR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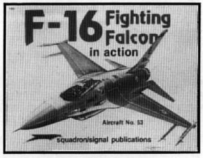


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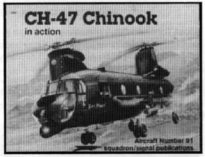


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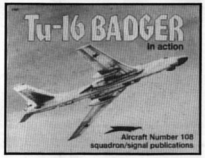


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This Tornado GR.1 of No 17 Squadron carries special markings applied to the squadron commander's aircraft to mark the unit's 75th anniversary.

A Tornado F.3 interceptor of the Royal Saudi Air Force. Tornado F.3s of both Nos 29 and 34 Squadrons have been active flying combat air patrol missions along the Saudi/Iraqi border. They were part of the air defense forces assigned to Operation DESERT STORM.

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